

CLAIMS:

1. An optical fiber for transmitting light used in optical fiber communication or optical devices, wherein
  - 5 at least a core region of said optical fiber is composed of tellurite glass with a zero-material dispersion wavelength equal to or greater than 2  $\mu\text{m}$ , and
  - 10 said optical fiber has air holes disposed in said optical fiber in a manner that confines light in a center of said optical fiber, thereby controlling the zero dispersion wavelength in a 1.2-1.7  $\mu\text{m}$  band.
2. The optical fiber as claimed in claim 1, further comprising a region with an area 0.1 to five times  $\pi\lambda^2$  at
  - 15 the center of said optical fiber, where  $\lambda$  is a wavelength of the light and  $\pi$  is the circular constant, wherein said air holes are disposed in an entire cross section of said optical fiber except for said region, or in locations surrounding said region in the cross section so that said
  - 20 region becomes the core for confining the light.
3. The optical fiber as claimed in claim 1, wherein said tellurite glass with the zero-material dispersion wavelength equal to or greater than 2  $\mu\text{m}$  has a composition
  - 25 of  $\text{TeO}_2\text{-Bi}_2\text{O}_3\text{-LO-M}_2\text{O-N}_2\text{O}_3\text{-Q}_2\text{O}_5$ , where L is at least one of Zn, Ba and Mg, M is at least one alkaline element selected from Li, Na, K, Rb and Cs, N is at least one of B, La, Ga,

Al and Y, and Q is at least one of P and Nb, and components of said tellurite glass are

50 < TeO<sub>2</sub> < 90 (mol%)

1 < Bi<sub>2</sub>O<sub>3</sub> < 30 (mol%) and

5 1 < LO + M<sub>2</sub>O + N<sub>2</sub>O<sub>3</sub> + Q<sub>2</sub>O<sub>5</sub> < 50 (mol%).

4. The optical fiber as claimed in claim 2, wherein said tellurite glass with the zero-material dispersion wavelength equal to or greater than 2  $\mu\text{m}$  has a composition

10 of TeO<sub>2</sub>-Bi<sub>2</sub>O<sub>3</sub>-LO-M<sub>2</sub>O-N<sub>2</sub>O<sub>3</sub>-Q<sub>2</sub>O<sub>5</sub>, where L is at least one of Zn, Ba and Mg, M is at least one alkaline element selected from Li, Na, K, Rb and Cs, N is at least one of B, La, Ga, Al and Y, and Q is at least one of P and Nb, and components of said tellurite glass are

15 50 < TeO<sub>2</sub> < 90 (mol%)

1 < Bi<sub>2</sub>O<sub>3</sub> < 30 (mol%) and

1 < LO + M<sub>2</sub>O + N<sub>2</sub>O<sub>3</sub> + Q<sub>2</sub>O<sub>5</sub> < 50 (mol%).

5. The optical fiber as claimed in claim 3, wherein said

20 tellurite material glass is doped with at least one type of rare-earth ions selected from Ce<sup>3+</sup>, Pr<sup>3+</sup>, Nd<sup>3+</sup>, Pm<sup>3+</sup>, Sm<sup>3+</sup>, Eu<sup>3+</sup>, Tb<sup>3+</sup>, Dy<sup>3+</sup>, Ho<sup>3+</sup>, Er<sup>3+</sup>, Tm<sup>3+</sup> and Yb<sup>3+</sup>.

6. The optical fiber as claimed in claim 4, wherein said

25 tellurite material glass is doped with at least one type of rare-earth ions selected from Ce<sup>3+</sup>, Pr<sup>3+</sup>, Nd<sup>3+</sup>, Pm<sup>3+</sup>, Sm<sup>3+</sup>, Eu<sup>3+</sup>, Tb<sup>3+</sup>, Dy<sup>3+</sup>, Ho<sup>3+</sup>, Er<sup>3+</sup>, Tm<sup>3+</sup> and Yb<sup>3+</sup>.

7. The optical fiber as claimed in claim 1, wherein said optical fiber is composed of tellurite glass and comprises: a core region; a first cladding section that is formed in 5 such a manner as to enclose said core region, and has a plurality of air holes in a circumferential direction of said core region and along an axial direction of said core region; and a second cladding section that is formed in such a manner as to enclose said first cladding section, 10 and has a refractive index approximately equal to an equivalent refractive index of said first cladding section.

8. The optical fiber as claimed in claim 3, wherein said optical fiber is composed of tellurite glass and comprises: 15 a core region; a first cladding section that is formed in such a manner as to enclose said core region, and has a plurality of air holes in a circumferential direction of said core region and along an axial direction of said core region; and a second cladding section that is formed in 20 such a manner as to enclose said first cladding section, and has a refractive index approximately equal to an equivalent refractive index of said first cladding section.

9. The optical fiber as claimed in claim 6, wherein said optical fiber is composed of tellurite glass and comprises: 25 a core region; a first cladding section that is formed in such a manner as to enclose said core region, and has a

plurality of air holes in a circumferential direction of said core region and along an axial direction of said core region; and a second cladding section that is formed in such a manner as to enclose said first cladding section,  
5 and has a refractive index approximately equal to an equivalent refractive index of said first cladding section.

10. The optical fiber as claimed in any one of claims 7-9, wherein said air holes of said first cladding section are  
10 formed at fixed intervals along the circumferential direction of said core region.

11. The optical fiber as claimed in any one of claims 7-9, wherein said air holes of said first cladding section are  
15 formed in a multilayer fashion in a radial direction of said first cladding section.

12. The optical fiber as claimed in any one of claims 7-9, wherein said air holes of said first cladding section are  
20 filled with a material having a refractive index lower than a refractive index of said second cladding section.

13. The optical fiber as claimed in any one of claims 7-9, wherein said core region has a refractive index higher than  
25 a refractive index of a material of said first cladding section.

14. The optical fiber as claimed in any one of claims 7-9, wherein a relative refractive-index difference between said core region and said first cladding section is equal to or greater than 2%.

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15. The optical fiber as claimed in any one of claims 7-9, wherein a central section to become said core has tellurite glass, a refractive index of which differs from the refractive index of said tellurite glass, embedded in said central section.

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16. The optical fiber as claimed in any one of claims 2-6, wherein a central section of a region to become said core has air holes formed in said central section.

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17. The optical fiber as claimed in claim 2, wherein said air holes are disposed in one of triangular lattice-like, quadrilateral lattice-like, and honeycomb geometries.

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18. The optical fiber as claimed in claim 2, wherein said air holes have one of geometries of circular cylinder, elliptical prism and polygonal prism.

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19. The optical fiber as claimed in any one of claims 2-6, wherein a number of said air holes is three, and a diameter of a region to become said core is 0.6-6.5  $\mu\text{m}$ .

20. The optical fiber as claimed in any one of claims 2-6, wherein a number of said air holes is four, and a diameter of a region to become said core is 0.6-5  $\mu\text{m}$ .

5 21. A fabrication method of the optical fiber using as a core material tellurite glass that has the zero-material dispersion wavelength equal to or greater than 2  $\mu\text{m}$  and has a composition of  $\text{TeO}_2\text{-Bi}_2\text{O}_3\text{-LO-M}_2\text{O-N}_2\text{O}_3\text{-Q}_2\text{O}_5$ , where L is at least one of Zn, Ba and Mg, M is at least one alkaline 10 element selected from Li, Na, K, Rb and Cs, N is at least one of B, La, Ga, Al and Y, and Q is at least one of P and Nb, and components of said tellurite glass are

50 <  $\text{TeO}_2$  < 90 (mol%)

1 <  $\text{Bi}_2\text{O}_3$  < 30 (mol%) and

15 1 < LO + M<sub>2</sub>O + N<sub>2</sub>O<sub>3</sub> + Q<sub>2</sub>O<sub>5</sub> < 50 (mol%), wherein said fabrication method of the optical fiber comprises:

a first process of forming a preform by cast molding tellurite glass melt into a mold having a plurality of portions to become convex on the inner wall; and

20 a second process of inserting said glass preform produced in said first process into a hollow cylindrical jacket tube composed of tellurite glass, and of carrying out fiber drawing under pressure with maintaining or enlarging air holes in a gap between said glass preform and said jacket 25 tube.

22. A fabrication method of the optical fiber using as

a core material tellurite glass that has the zero-material dispersion wavelength equal to or greater than 2  $\mu\text{m}$  and has a composition of  $\text{TeO}_2\text{-Bi}_2\text{O}_3\text{-LO-M}_2\text{O-N}_2\text{O}_3\text{-Q}_2\text{O}_5$ , where L is at least one of Zn, Ba and Mg, M is at least one alkaline element selected from Li, Na, K, Rb and Cs, N is at least one of B, La, Ga, Al and Y, and Q is at least one of P and Nb, and components of said tellurite glass are

5            $50 < \text{TeO}_2 < 90$  (mol%)

10            $1 < \text{Bi}_2\text{O}_3 < 30$  (mol%) and

10            $1 < \text{LO} + \text{M}_2\text{O} + \text{N}_2\text{O}_3 + \text{Q}_2\text{O}_5 < 50$  (mol%), wherein said fabrication method of the optical fiber comprises:

15           a first process of forming a preform by cast molding tellurite glass melt into a mold having a plurality of portions to become convex on the inner wall which is conically enlarged towards a bottom of said inner wall; a second process of forming a glass preform by injecting glass melt of core glass composed of tellurite glass, and by suction molding the core glass conically by volume contraction of the cladding glass; and

20           a third process of inserting said glass preform produced by said second process into a hollow cylindrical jacket tube composed of tellurite glass, and of carrying out fiber drawing under pressure with maintaining or enlarging air holes in a gap between said glass preform and said jacket tube.

23. A fabrication method of the optical fiber using as

a core material tellurite glass that has the zero-material dispersion wavelength equal to or greater than 2  $\mu\text{m}$  and has a composition of  $\text{TeO}_2\text{-Bi}_2\text{O}_3\text{-LO-M}_2\text{O-N}_2\text{O}_3\text{-Q}_2\text{O}_5$ , where L is at least one of Zn, Ba and Mg, M is at least one alkaline element selected from Li, Na, K, Rb and Cs, N is at least one of B, La, Ga, Al and Y, and Q is at least one of P and Nb, and components of said tellurite glass are

5            $50 < \text{TeO}_2 < 90$  (mol%)

10            $1 < \text{Bi}_2\text{O}_3 < 30$  (mol%) and

10            $1 < \text{LO} + \text{M}_2\text{O} + \text{N}_2\text{O}_3 + \text{Q}_2\text{O}_5 < 50$  (mol%), wherein said fabrication method of the optical fiber comprises:

15           a first process of forming a preform by cast molding tellurite glass melt into a mold that has a plurality of portions to become convex on the inner wall which is conically enlarged towards a bottom of said inner wall, and that has a hole in the bottom of said mold;

20           a second process of forming a glass preform by injecting glass melt of core glass composed of tellurite glass, and by suction molding the core glass conically by volume contraction of the cladding glass and by causing the cladding glass to flow out of said hole; and

25           a third process of inserting said glass preform produced by said second process into a hollow cylindrical jacket tube composed of tellurite glass, and of carrying out fiber drawing under pressure with maintaining or enlarging air holes in a gap between said glass preform and said jacket tube.

24. The fabrication method of the optical fiber as claimed in any one of claims 21-23, wherein said mold has four portions convex on the inner wall, and the cladding of said 5 optical fiber has four air holes.

25. The fabrication method of the optical fiber as claimed in claim 23, wherein said second process carries out vacuum degassing through said hole to cause said cladding glass 10 to flow out of said hole.

26. A fabrication method of the optical fiber using as a core material tellurite glass that has the zero-material dispersion wavelength equal to or greater than 2  $\mu\text{m}$  and 15 has a composition of  $\text{TeO}_2\text{-Bi}_2\text{O}_3\text{-LO-M}_2\text{O-N}_2\text{O}_3\text{-Q}_2\text{O}_5$ , where L is at least one of Zn, Ba and Mg, M is at least one alkaline element selected from Li, Na, K, Rb and Cs, N is at least one of B, La, Ga, Al and Y, and Q is at least one of P and Nb, and components of said tellurite glass are

20  $50 < \text{TeO}_2 < 90$  (mol%)

$1 < \text{Bi}_2\text{O}_3 < 30$  (mol%) and

$1 < \text{LO} + \text{M}_2\text{O} + \text{N}_2\text{O}_3 + \text{Q}_2\text{O}_5 < 50$  (mol%), wherein said fabrication method of the optical fiber comprises:

a first process of forming a cylindrical glass block 25 by cast molding tellurite glass melt into a mold;

a second process of forming a glass preform having air holes by boring holes in a longitudinal direction of said

glass block formed in said first process; and  
a third process of inserting said glass preform produced  
by said second process into a hollow cylindrical jacket  
tube composed of tellurite glass, and of carrying out fiber  
5 drawing under pressure with maintaining or enlarging air  
holes in a gap between said glass preform and said jacket  
tube.

27. A fabrication method of the optical fiber using as  
10 a core material tellurite glass that has the zero-material  
dispersion wavelength equal to or greater than 2  $\mu\text{m}$  and  
has a composition of  $\text{TeO}_2\text{-Bi}_2\text{O}_3\text{-LO-M}_2\text{O-N}_2\text{O}_3\text{-Q}_2\text{O}_5$ , where L is  
at least one of Zn, Ba and Mg, M is at least one alkaline  
element selected from Li, Na, K, Rb and Cs, N is at least  
15 one of B, La, Ga, Al and Y, and Q is at least one of P and  
Nb, and components of said tellurite glass are

$$50 < \text{TeO}_2 < 90 \text{ (mol\%)}$$

$$1 < \text{Bi}_2\text{O}_3 < 30 \text{ (mol\%) and}$$

1 < LO + M<sub>2</sub>O + N<sub>2</sub>O<sub>3</sub> + Q<sub>2</sub>O<sub>5</sub> < 50 (mol%), wherein said  
20 fabrication method of the optical fiber comprises:

a first process of forming a preform having air holes  
formed by cast molding tellurite glass melt into a mold  
having a jig including a plurality of cylindrical rodlike  
pins disposed on a base inside the mold, followed by  
25 extracting said jig; and

a second process of inserting said glass preform produced  
in said first process into a hollow cylindrical jacket tube

composed of tellurite glass, and of carrying out fiber drawing under pressure with maintaining or enlarging the air holes in a gap between said glass preform and said jacket tube.